Air & Space

National Air & Space Museum
Smithsonian Institution

Vol. 1 No. 2 April 1978

Experiencing Air and Space First-Hand

Matthew McLean of Germantown, Maryland, above, "flies" a working Link trainer at the National Air and Space Museum. Field trips to such exhibits in museums, to airports and flight-related offices give students a realistic sense of what's involved and how large a part of life aviation has become. It's harder to find objects for an equivalent impression of spaceflight. Yet any teacher, anywhere, with readily available radio equipment, can let students listen to an orbiting satellite, daily, and use it in their studies. See the OSCAR story inside.

INSIDE: "General Aviation" Flying, Page 3 The Man-Powered Gossamer Condor, Pages 6-7. Tuning in to OSCAR, Pages 8-9.

Sharing —

Materials from the National Air and Space Museum

This Museum's Library is one of 135 locations throughout the nation which have been designated Aviation Education Resource Centers (AERC) for the collection and relay of aerospace materials. Among numerous leaflets available here on request are:

Langley's Aerodrome. Powered flights of 1896 preceded the better-known successes of the Wrights.

The Wright Brothers. Many celebrations are already planned for December 17, 1978, the 75th anniversary of an historic "first."

Charles A. Lindbergh and the Spirit of St. Louis. This folder includes diagrams of the plane and a list of available photographs.

For copies, educators write to Catherine Scott, Librarian (Museum address on the back cover). A list of all AERCs is available from the sponsor, General Aviation Manufacturers Association, 1025 Connecticut Ave. NW, Washington, DC 20036.

Briefing From the Director

Michael Collins

The publication you are reading will focus on air and space, but I thought you might like to know a little bit about this Museum's parent, the Smithsonian Institution. It's a fascinating, diverse and dynamic national asset.

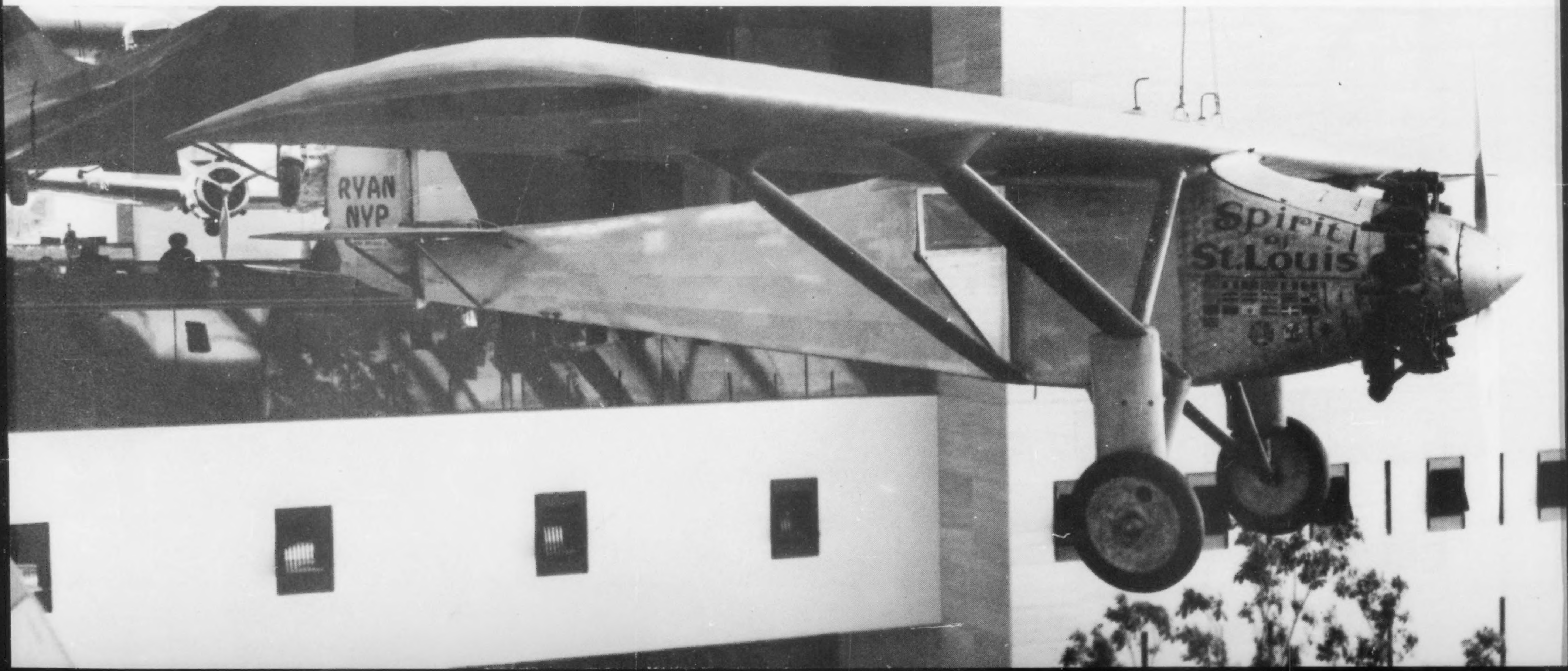
James Smithson (1765-1829) was the illegitimate son of the Duke of Northumberland. Born in France, educated at Oxford, and buried in Italy, Smithson was a self-taught mineralogist and chemist. (The mineral Smithsonite is named after him.) Although he had never been to the United States, something about this country must have intrigued him, because he left his entire estate to establish ". . . in the city of Washington . . . an establishment for the increase and diffusion of knowledge . . ."

After debating the propriety of this bequest for eight years, Congress finally decided to accept Mr. Smithson's $500,000, and appointed a Board of Regents to guide the fledgling Institution. By 1855 its new home, a romantic stone castle designed by James Renwick, was completed on the Mall, one kilometer west of the Capitol.

Today, the Smithsonian is an Institution whose complexity and diversity would, I think, astound and delight James Smithson. The governing board, the Regents, remain nearly the same (the Chief Justice of the United States, the Vice President, three Congressmen, three Senators, and six private citizens) but Renwick's Castle is now but the central core of a system of museums and research facilities international in scope. In addition to the National Air and Space Museum, five other Smithsonian museums are located along the Mall—that strip of green separating the Capitol from the Washington Monument. The Museum of History and Technology, which covers virtually everything in American history books, from

Continued on opposite page

Below, one of the most beloved exhibits in the National Air & Space Museum is the actual Ryan NYP, the single-engined monoplane which Charles A. Lindbergh flew on his historic transatlantic crossing in 1927. Students can compare "The Spirit of St. Louis" with today's private planes (opposite page), especially the Cessna at the top, which also has a braced, high wing and non-retractable landing gear.



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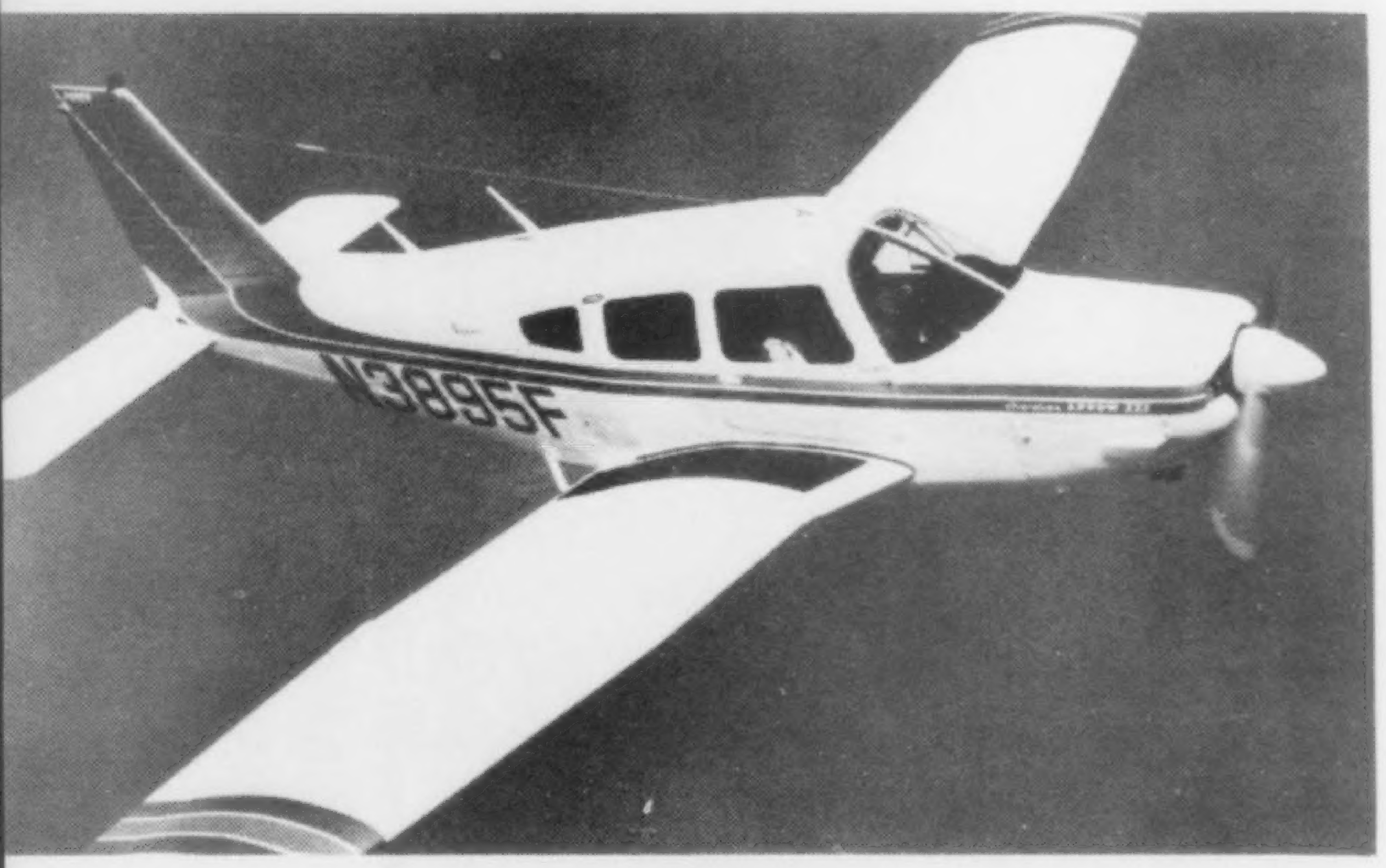
National Air and Space Museum
Room 3569
The Smithsonian Institution
Washington, DC 20560

Simulated flight in the Link GAT-1 shown on the cover of this issue would help prepare a beginner for flying the kind of small, private, or business planes shown on this page. Top: Cessna 1977-185 Skywagon; first below: Piper Cherokee Arrow III; second below: Beechcraft Turbo Bonanza (note V-shape tail).



"General Aviation" Flying

Many of the 1,540 flying schools in the U.S. use trainers like the GAT-1 flight simulator shown on the cover. In these, a novice can learn how to manage an aircraft, or a pilot can perfect his skills, without actually flying and burning fuel unnecessarily.

Teachers can call nearby flight schools to learn of any Open House dates or other opportunities for classes to see and perhaps try out simulators. The GAT-1 is a fairly simple trainer but ideal for those who plan to fly only small aircraft like the ones pictured on this page.

These belong in the broad category of "general aviation," which encompasses everything except military aviation and scheduled commercial transport.

Today there are more than 178,000 aircraft in use in "general aviation" with some 744,000 pilots licensed to fly them. In 1975 they made 40 million intercity flights, totaling 34½ million hours in the air.

Sport flying accounts for only five percent of "general aviation." Business flights, commuter and air taxi service, instructional and rental use, and flights to accomplish such work as surveying, agricultural service and even displaying advertising banners make up a hefty business employing about 250,000 people and contributing $5 billion to the Gross National Product.

A class can discuss what it means for a town to have an airport, even a grassy field. It makes possible local deliveries and shipments by air, and connections to major airlines. Many businesses will not settle where there is no air service. What are drawbacks? Noise? What are the tradeoffs between noise for residents near an airport versus service to an entire area?

This spring, the National Air and Space Museum opens a new General Aviation Gallery. Visitors learn the basics of flying from films and trained instructors at simulators, including three GAT-1s "flying over" photomural landscapes. The Museum is open seven days a week, from 10:00 a.m. to 9:00 p.m. in summertime.

Briefing from the Director

Continued from Page 2

postage stamps to locomotives, has 16 million objects in its collections. If you think that's a lot, consider the Museum of Natural History, which shows an inventory of 60 million items, and includes everything from worms to dinosaur bones.

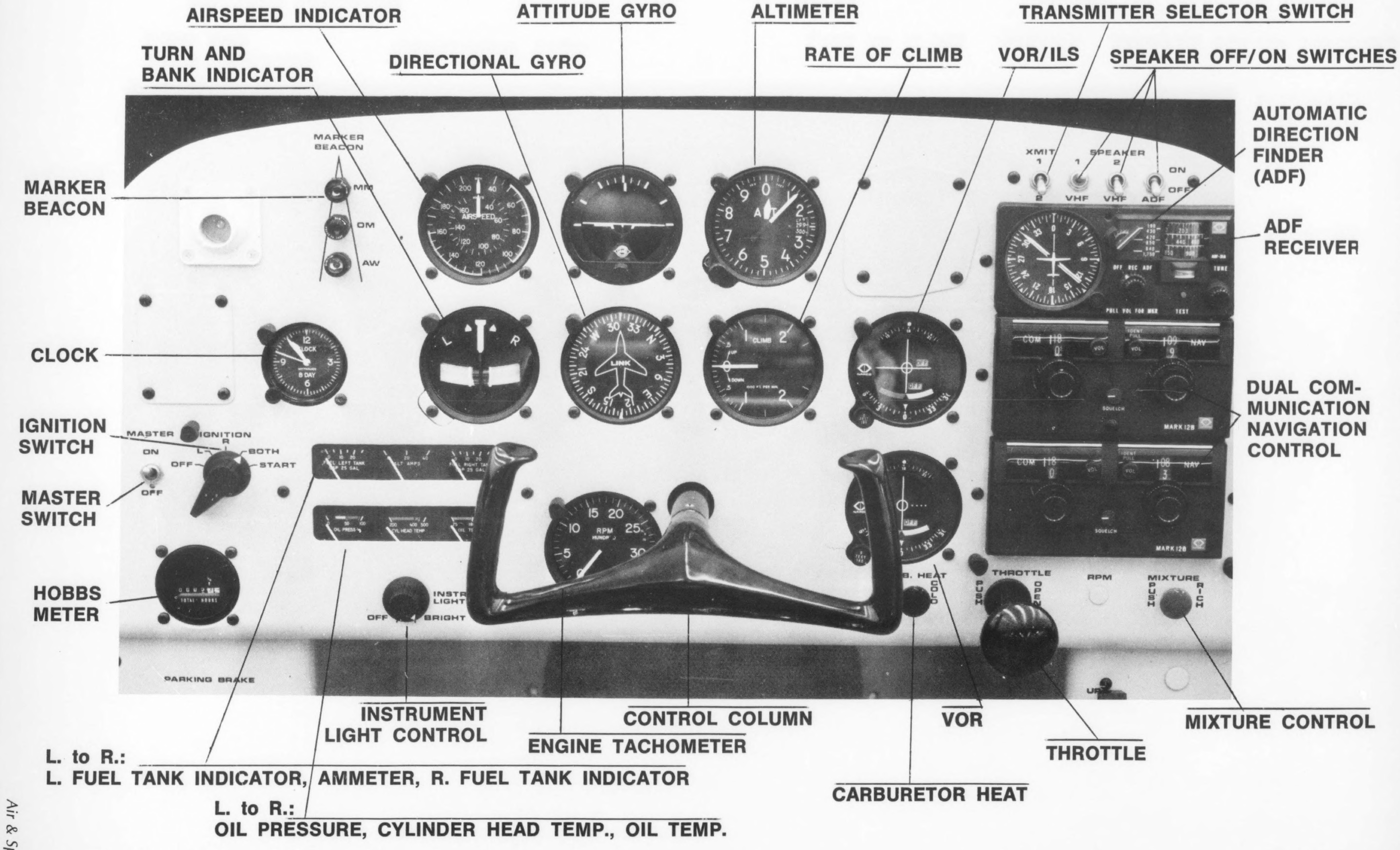
The Hirshhorn Museum, a relative newcomer to the Smithsonian, features modern art in spectacular circular galleries and in a sculpture garden, while its neighbor, the Freer Gallery, has an exquisite collection of oriental art. The Arts and Industries Building, originally built to house artifacts from the Philadelphia centennial exhibit of 1876, has now recreated this exhibit in a charming period setting.

Off the Mall, but still close by in Washington, are the Anacostia Neighborhood Museum, the National Collection of Fine Arts, and the National Portrait Gallery. A large chunk of beautiful Rock Creek Park is devoted to the National Zoological Park, where visitors can see a pair of pandas presented by the People's Republic of China, or a family of white tigers playing in an enclosure without bars.

Outside of Washington, the Smithsonian runs an ecological research center on Chesapeake Bay, an astrophysical observatory in Cambridge, Massachusetts, and a tropical research facility in the Panama Canal Zone. There are Smithsonian telescopes on mountain tops in Arizona and Smithsonian scientists on research expeditions on every continent around the globe.

Thank you, Mr. Smithson.

INSTRUMENT PANEL IN THE LINK GENERAL AVIATION TRAINER (GAT-1)


AIRSPEED INDICATOR
ATTITUDE GYRO
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TRANSMITTER SELECTOR SWITCH
TURN AND BANK INDICATOR
DIRECTIONAL GYRO
RATE OF CLIMB
VOR/ILS
SPEAKER OFF/ON SWITCHES
AUTOMATIC DIRECTION FINDER (ADF)
ADF RECEIVER
MARKER BEACON
CLOCK
IGNITION SWITCH
MASTER SWITCH
HOBBS METER
DUAL COMMUNICATION NAVIGATION CONTROL
INSTRUMENT LIGHT CONTROL
CONTROL COLUMN
ENGINE TACHOMETER
VOR
THROTTLE
MIXTURE CONTROL
CARBURETOR HEAT
L. to R.: L. FUEL TANK INDICATOR, AMMETER, R. FUEL TANK INDICATOR
L. to R.: OIL PRESSURE, CYLINDER HEAD TEMP., OIL TEMP.
MARKER BEACON
MM
OM
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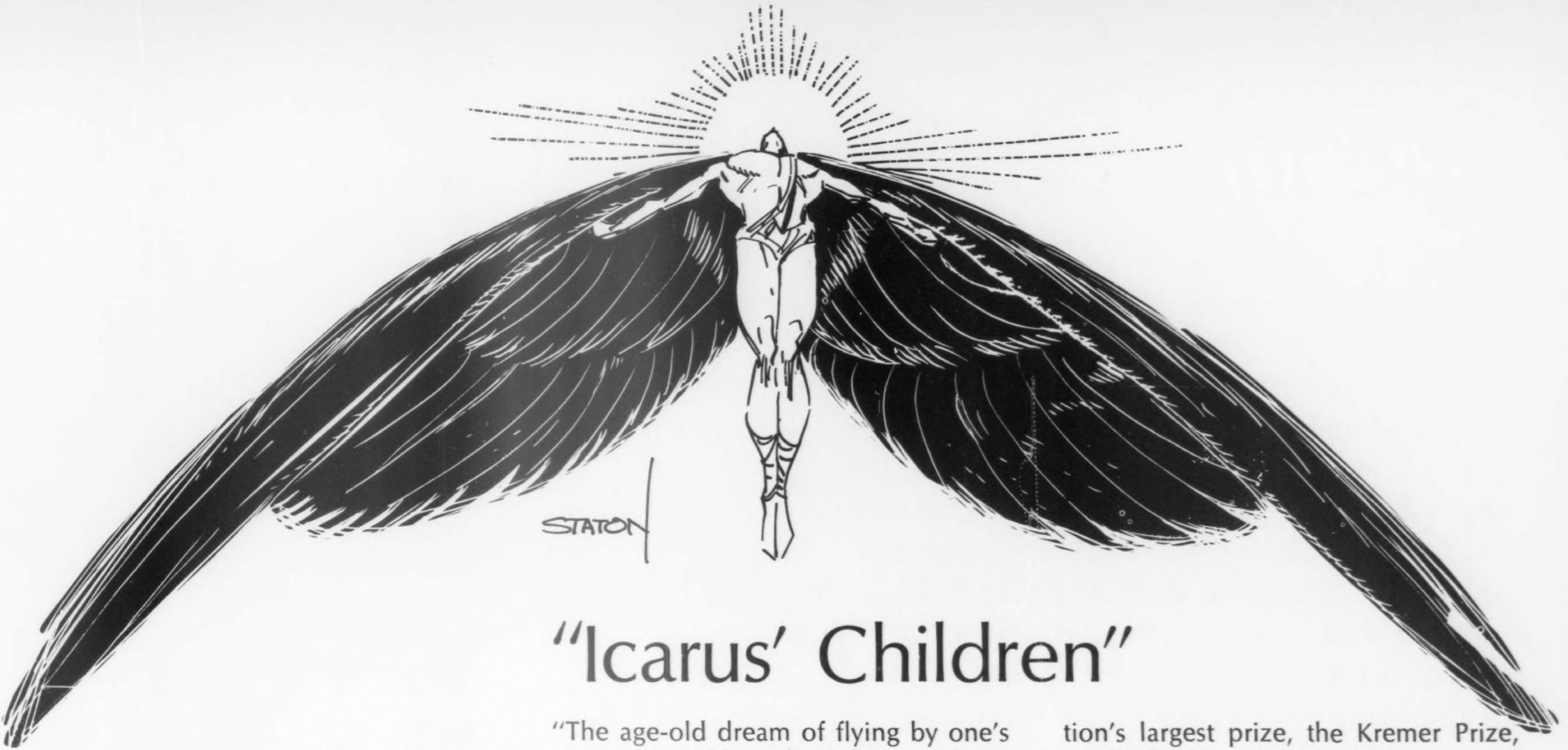
XMIT
SPEAKER
VHF
ADF
ON
OFF
MASTER
IGNITION
BOTH
START
THROTTLE
RPM
MIXTURE
PARKING BRAKE
MARK 12B

A GAT-1 instrument panel may seem unusually complicated to the driver of a Pinto, Beetle or Mustang. And compared to the small cluster of instruments to be found in a Piper J-3 Cub of the 1930s, the GAT-1 panel is a bit more sophisticated. However, compared to the flight-deck of a Boeing 747, the GAT-1 is simplicity itself. Nevertheless, as bewildering as the array of instruments may appear at first glance, it can be mastered with patience and study. Once the student pilot learns the functions of each of the gauges and controls, and becomes aware of the role each plays during flight, the rest becomes a matter of practice and concentration, until the student can demonstrate complete mastery of the cockpit by touching each instrument—blindfolded.

Tim Wooldridge

This and all other pages in Air & Space may be freely photocopied for students and any educational use.



"Icarus' Children"

"The age-old dream of flying by one's own power, like a bird, has not been abandoned in the age of jet aircraft," notes the bimonthly *Teacher's Guide to NOVA* for February-March, 1978, in describing the telecast, "Icarus' Children." It is one of the highly rated shows in the NOVA series produced at station WGBH, Boston and distributed by Public Broadcasting Service. Beginning with the Greek myth of Icarus, the telecast dramatizes historic efforts to fly by the use of muscle-power alone, and shows some of the man-powered craft mentioned in the story of the Gossamer Condor, Pages 6, 7, and 12 of this publication.

All these were built in the hope of winning what is believed to be aviation's largest prize, the Kremer Prize, established in 1959 (and not won until 1977). The PBS airdate for "Icarus' Children" is the week of March 27; teachers can learn the date of repeats by calling the local Public Broadcasting station. These stations give away the *Teacher's Guides* to the NOVA shows for a two-month period. The illustrated booklets offer a synopsis of each show, a statement of viewing goals, a bibliography, suggested activities and discussion topics. The Guides are prepared in cooperation with the National Science Teachers Association, the National Council for the Social Studies, and the American Association of School Librarians.

May 3 — Tribute to Solar Energy

"Sun Day"—that's Wednesday, May 3, when a coalition of many interests will be staging exhibits and events, nationwide, to focus attention on solar energy. "The Sun's appeal is enormous," writes one of the organizers of the movement. "Sunlight is delivered every morning without powerlines or fuel trucks; it doesn't pollute; it won't run out; and it can't be diverted by hijackers, terrorists or international cartels." For information write Sun Day, 1028 Connecticut Ave. NW, Room 1100, Washington, DC 20036.

A brief, basic, easily read booklet on the Sun is *Skylab and the Sun*, by numerous noted authors, paperback, 8 by 10 in., 52 pp., illus., NASA EP 119, from Government Printing Office, Washington, DC 20402, Stock No. 033-000-00533-4, $1.10.

For free literature, write to Solar Heating, P.O. Box 1607, Rockville, Maryland 20850, or call toll-free: 800/523-2929.

For Fact Sheets on solar energy, write to Don Duggan, Education Department, U.S. Department of Energy, 400 First St. NW, Room 307, Washington, DC 20545.

On Aerospace Careers

Guidance counselors may want this: *Within Your Lifetime, Careers in Aerospace,* 8½ by 11 in., 16-page booklet, free on request to Jeffrey Irons, Director of Student Programs, American Institute of Aeronautics and Astronautics, 1290 Avenue of the Americas, New York, NY 10019.

In the Next Issue

Features in *Air & Space,* May issue:

"Learning about Earth's Family, the Nine Children of the Sun, the Solar System," with photos of planets.

"But Does It Fly?"—basics of aerodynamics, the story of wind tunnels, and the plan of a small tunnel for Industrial Arts classes to build.

NASA Resources

Kits of assorted printed materials on the U.S. space program will be sent to educators at no cost, on request to the appropriate National Aeronautics and Space Administration (NASA) Center named below. These kits include a Catalog of the hundreds of films available on loan for only the payment of return postage.

Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont:
National Audiovisual Center, Order Sect.
General Services Administration
Washington, DC 20409

Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming:
NASA Ames Research Center
Moffett Field, California 94035

Alabama, Arkansas, Iowa, Louisiana, Mississippi, Missouri, Tennessee:
NASA Marshall Space Flight Center
Alabama 35812

Delaware, District of Columbia, Maryland, New Jersey, Pennsylvania:
NASA Goddard Space Flight Center
Greenbelt, Maryland 20771

Florida, Georgia, Puerto Rico, Virgin Islands:
NASA Kennedy Space Center
Florida 32899

Kentucky, North Carolina, South Carolina, Virginia, West Virginia:
NASA Langley Research Center
Hampton, Virginia 23665

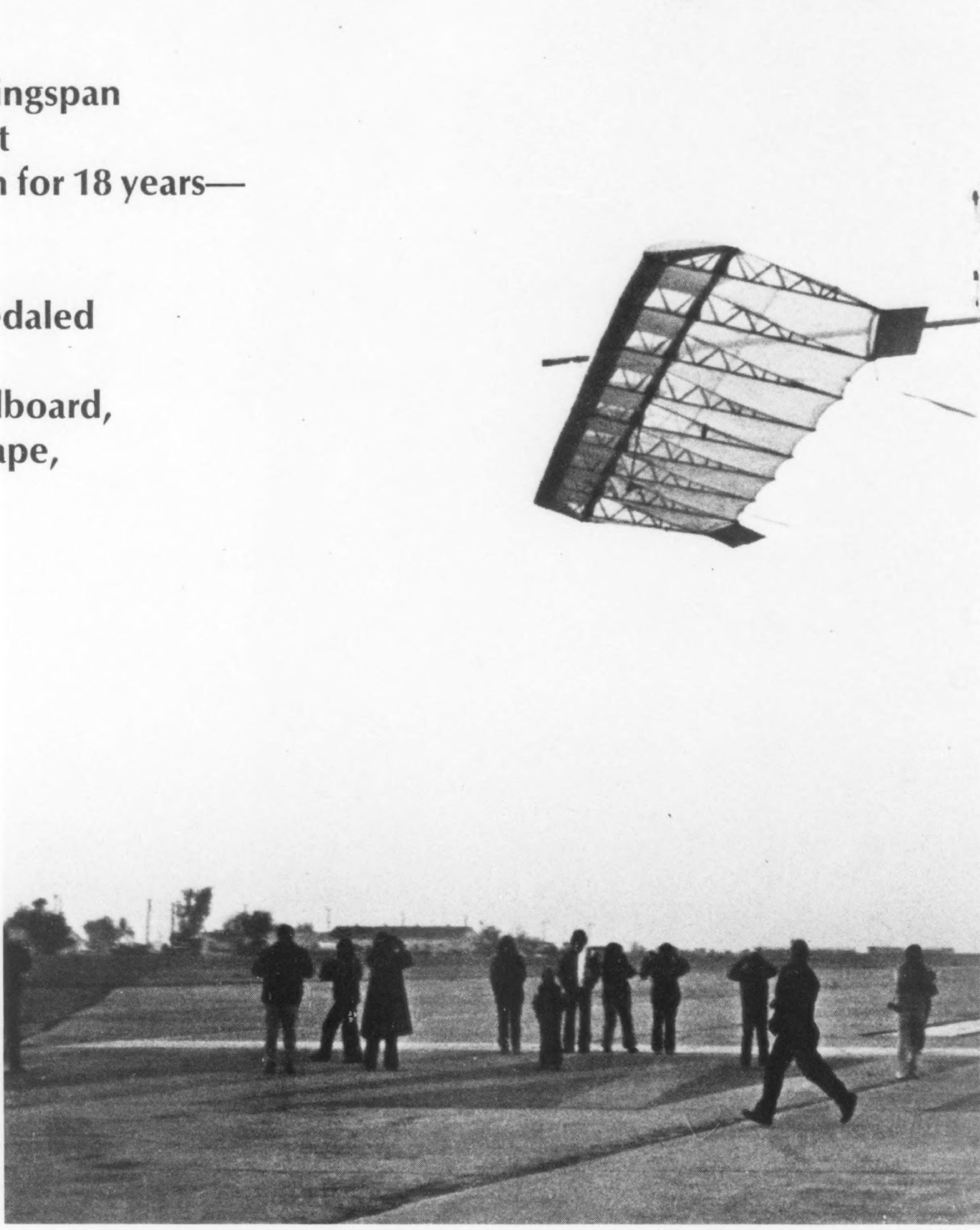
Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin:
NASA Lewis Research Center
Cleveland, Ohio 44135

Colorado, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas:
NASA Johnson Space Center
Houston, Texas 77058

The Improbable, Prize-Winning Goss

This fragile, shimmering craft, with a 96-foot wingspan but a total weight of only 70 pounds, finally met the challenge of the Kremer Competition, open for 18 years—sustained, maneuverable, man-powered flight over a prescribed course. On August 23, 1977, near Bakersfield, California, the Condor was pedaled to victory by a bicyclist, whose foot-power turned the propeller. Built of mylar, balsa, cardboard, thinned-down tubing, piano wire and Scotch tape, elegantly engineered, it won the British prize of £50,000, and brought honor to the U.S.

Some teachers may have students who enjoy sketching plans for futuristic aircraft or spacecraft. This story is about what it really takes to make a new idea work—a lot of math and special training, along with creative intuition. The Gossamer Condor may look as though it were Scotch-taped together for fun, but it is the product of sophisticated aeronautical engineering. Both designers, Dr. Paul B. MacCready and Dr. Peter Lissaman, earned their Ph.D.s in that field. Their full-time work is with Dr. MacCready's engineering firm in Pasadena, California.



The Gossamer Condor is now on exhibit at the National Air and Space Museum,

The Name

"Gossamer," of course refers to the shimmering, clear mylar film used as the skin for all surfaces. "Condor" is the enormous bird found in the Rocky Mountains of the U.S. and the Andes Range of South America. The word comes from the ancient Quechua language of highland Peru.

The Myth

The story of Icarus, in Greek myth, preserves an old longing of the human race, to fly like a bird. Icarus flew, all right, with feathered wings strapped to his arms by his inventor-father, Daedalus. But the flight plan was bad for the technology involved; he went too close to the Sun. Heat melted the wax which held the feathers together, and Icarus plunged into the Aegean Sea.

The Challenge

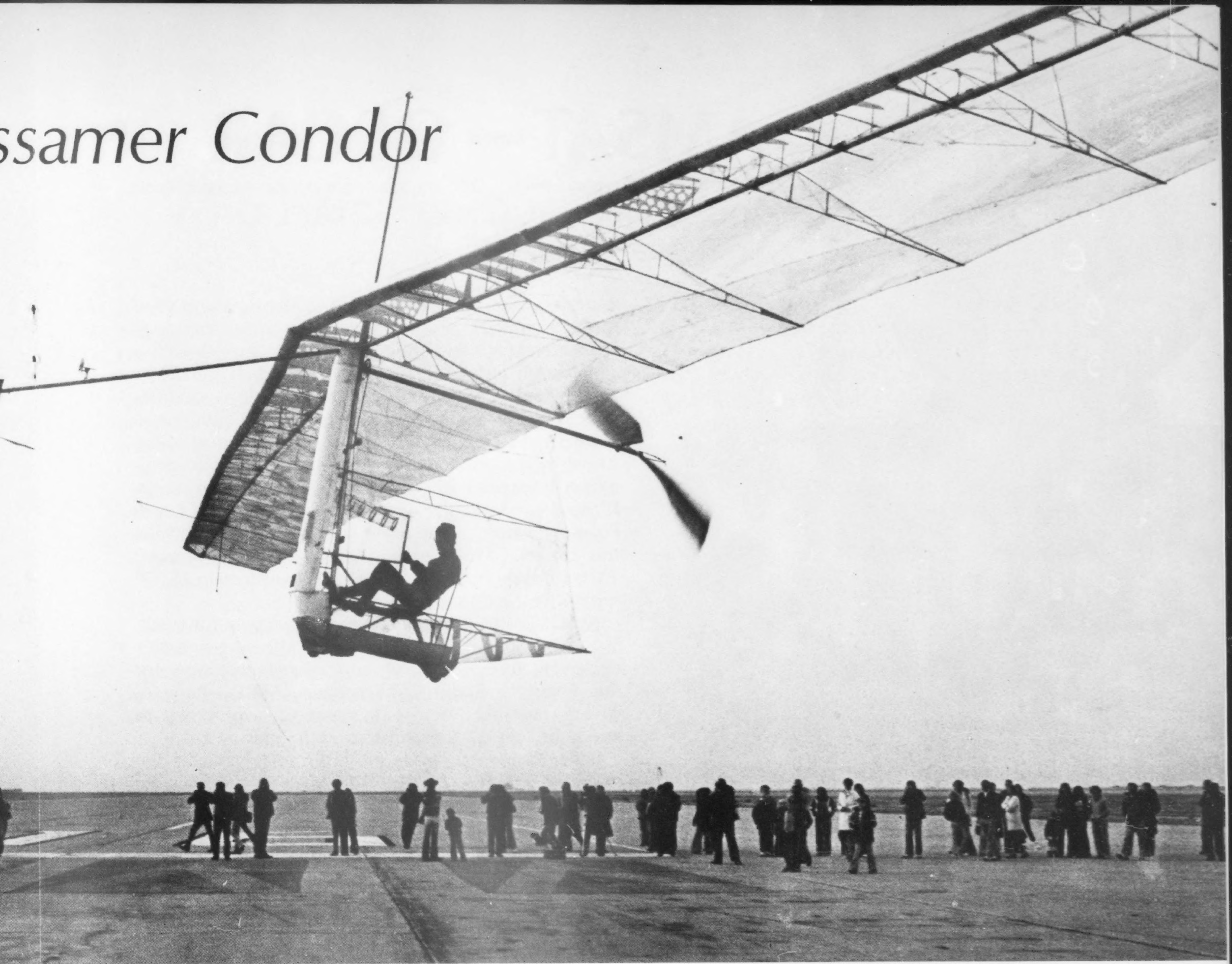
That mythical mishap has not deterred others. In the 16th century, Leonardo da Vinci sketched flying machines. Many "bird-men" have leaped from heights with sad results, trusting to devices built before the science of aerodynamics had evolved—that is, knowledge of the way the air interacts with objects passing through. The Wright brothers worked scientifically, with their own wind tunnel studies, before making the first successful powered flight on December 17, 1903.

Tim Wooldridge of NASM's Aeronautics Division writes of recent attempts:

"On November 9, 1961, glider pilot Derek Piggott furiously pedaled a large glider-like machine down the runway at Lasham Field in Hampshire, England. It lifted off and rose to an altitude of six feet, flew 50 yards down the runway, and landed intact. This was the first time in history that man had risen from a level surface under his own power and accomplished a controlled flight with a safe landing. The fragile craft was called SUMPAC (Southampton University's Man-Powered Aircraft) and was one of the many similar attempts to build a successful man-powered aircraft (MPA) which have occurred since the end of World War II.

"SUMPAC and its competitors were inspired by the Kremer Competition, which was established in 1959 by Henry Kremer, a British industrialist. The rules of the Kremer Competition

ssamer Condor



eum, Washington DC.

Photograph by Don Monroe

stipulated that the competing machine can be powered solely by the crew (no limit to the number of members). No energy storage or lighter-than-air gases were permitted. The course involved unassisted takeoff and flight on a figure-eight course around two pylons set at least one-half mile apart, crossing the starting-and-finishing-line at least 10 feet above the ground. Wind was not to exceed 10 knots.

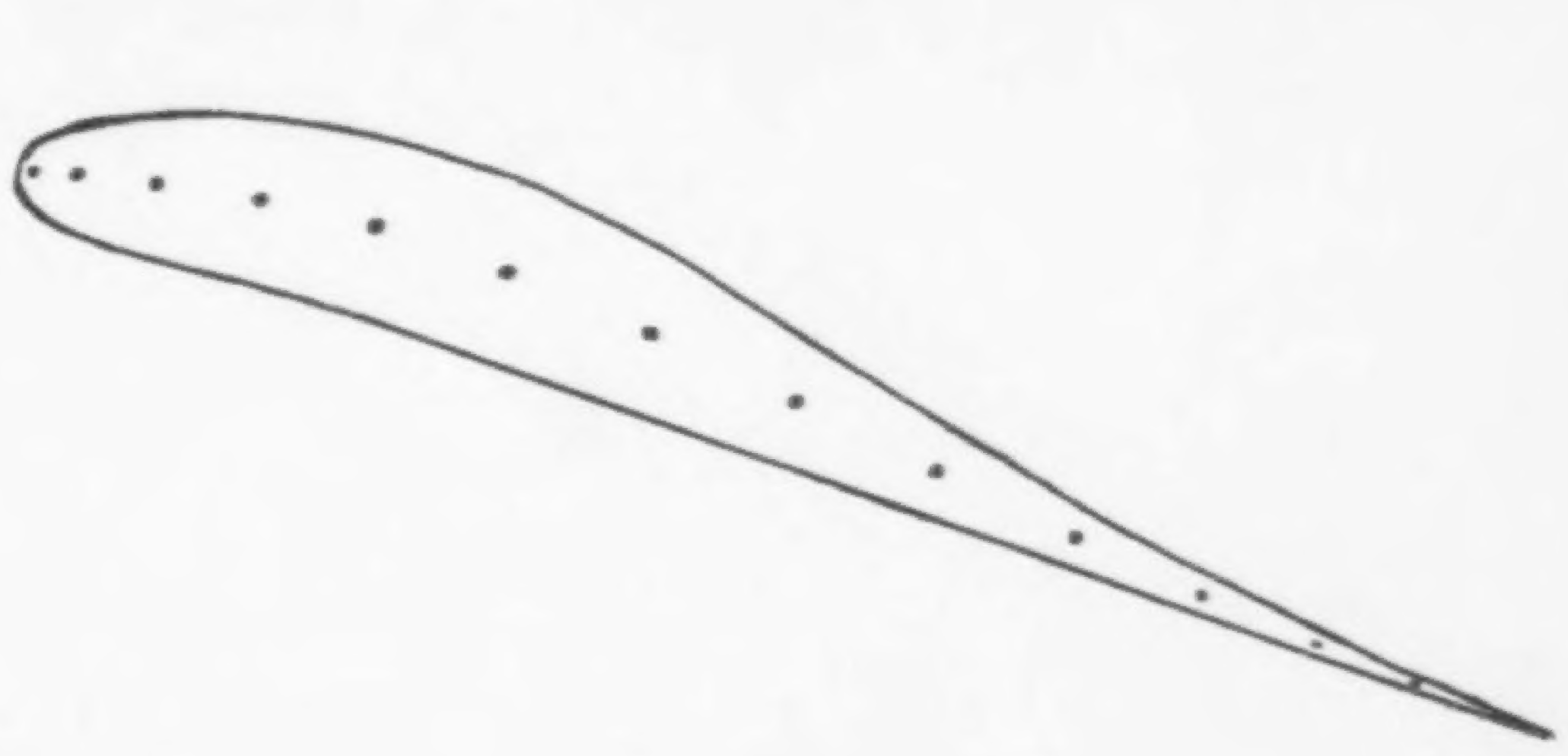
"Efforts to win the Kremer Prize by some 50 individuals or groups in Great Britain, Japan, and lately, the United States, have produced 20 different MPA planes and raised many questions.

"How much power can a person produce, and still exercise adequate control over a marginally stable aircraft? Should the person be a highly trained athlete who has been taught to fly, or a pilot who is in excellent physical shape? How many people should be in the flight crew? What should be the configuration of the aircraft—helicopter, ornithopter, monoplane, hexaplane (photograph, Page 12)? How large should the wingspan be? How shall the sensitivity of an MPA to gusty winds be countered? And, of extreme importance, how is the weight of the aircraft to be kept to a minimum?"

The Response

Here are some of the answers evolved by the Gossamer Condor designer, Paul MacCready, who put $50,000 of his own into the project:

The wing is given a rounded front edge with a slight nose droop; the bottom is flat.



Condor is designed for the slowest possible speed so that external braces could be made of wire for great savings in weight, and little drag.

The pilot reclines slightly. This is not an ideal position for him but it allows eight percent less weight in the structure. Such tradeoffs are called "systems engineering," when some parts of the whole may not be at their best, but they contribute to maximum overall effectiveness.

Continued on Page 11

AMSAT — OSCAR

Radio Amateur Satellite Corporation — Orbiting Satellite Carrying Amateur Radio

Many teachers have found that students take a vivid interest in math, physics, geography, social studies or space science when their projects are linked with a satellite in orbit. OSCARs, designed by and for radio "hams," are the only communications satellites which can be used with inexpensive radio equipment.

When teachers arrange for a class demonstration, or set up a permanent station, one of the first projects is to predict when OSCAR will be within range. It moves in a circular orbit over the North and South Poles, and stays in the same "track." But meanwhile, this planet continues to rotate inside that "track." Therefore, each pass of OSCAR 7 is over terrain 28.75° farther west than the preceding one.

An OSCARLOCATOR is a graphic device for tracking. Steve Place (photo, top left) is showing one to a class. He directs OSCAR educational programs for the American Radio Relay League (ARRL), many of whose members across the country volunteer to stage an OSCAR demonstration in classrooms.

When students gather around a receiver and the operator is tuning to 29.450 MHz, there's tantalizing suspense . . . OSCAR 7 is on its way . . . there, suddenly, are the first faint beeps or voices. OSCAR zooms into range, racing at 25,000 kilometers an hour (16,000 mph). It can be heard for about 20 minutes before it vanishes over the opposite horizon on its dash around the world, once every hour and 55 minutes. The series of OSCARs to be launched beginning in 1979 or 1980 will fly an elliptical orbit, and will be useable up to 20 hours a day.

OSCAR relays voice, slow-scan television, radio teletype and Morse Code transmissions. Morse Code numbers are telemetered for automatic reports on the condition of equipment onboard. Classes tape-record these transmissions and play them back slowly so that all students have time to decode the messages, and perhaps fill in report forms. These are provided by the organization which coordinates the design, building and operation of the OSCARs, the Radio Amateur Satellite Corporation, called AMSAT. When monitoring reports are mailed to AMSAT headquarters (P. O. Box 27, Washington, DC 20044), they are acknowledged with a colorful confirmation "QSL" card ("ham" radio language).

The operating data provide clues to Earth's reflectiveness (albedo), auroral conditions, the solar con-

Top, Steve Place, OSCAR Education Program Manager at the American Radio Relay League, explains the use of an OSCARLOCATOR to a class at the Plainville, Connecticut, High School. Students calculate the time and location of OSCAR's next overhead pass; two of them aim the antenna properly. Only basic radio equipment is required.

The Communications Satellite of the Radio "Hams" Who Help Teachers Set Up a Classroom Station

stant and other factors. Doppler shift is easy to study because of the fast transit. With such data, students can do significant research and projects.

When students understand OSCAR, they can more readily grasp how hundreds of manufactured satellites now swarm around this planet, observing Earth and relaying information on a global scale. Businessmen, environmentalists, geologists . . . a number of interests are already using instruments in space, and using satellite communications. In many careers, young people will be ahead if they are aware of the present and potential uses of satellites.

Ninety percent of what can be taught with OSCAR can be done with only a receiver. For two-way communications, an operator must be present who is licensed by the Federal Communications Commission. Under his or her supervision, non-licensed students may go on the air and speak with others within OSCAR's 5,000 mile range.

A receiving station made of used or surplus equipment may cost $125 to $200. A receive-and-transmit station might come to $600. Citizens Band equipment (CB) can be modified for around $100 but considerable expertise is needed.

The first experimental OSCAR was flown in 1961. If all went well, the eighth was hurled into orbit March 5, along with Landsat-C. That was after this issue of *Air & Space* went to press. All OSCARs have been built as a hobby by radio amateurs and a variety of people in several nations, under the guidance and coordination of AMSAT.

The National Aeronautics and Space Administration (NASA) has been choosing these to launch free because of their educational value. They are so light and small that no extra fuel and other launch requirements are involved.

Teachers asking ARRL for information, on school letterhead, will receive at no cost one copy each of material such as *Space Science Involvement* (a curriculum guide), *Getting to Know OSCAR from the Ground Up* (a "how-to" manual), *Guidelines for a Demonstration,* and OSCARLOCATOR, and more. ARRL can also lend a video cassette or slide show.

Funded by the National Science Foundation, Dr. Martin R. Davidoff of Catonsville Community College, Maryland, has just completed a textbook, *Using Satellites in the Classroom, A Guide for Science Educators.* NSF limits his own distribution to colleges and universities. However, the National Air and Space Museum staff believes that some advanced high school classes could use it, and has ordered an extra 500 copies, available in May. These will be given away on a first-come, first-served basis. Write to the *Air & Space* editor (address on back cover).

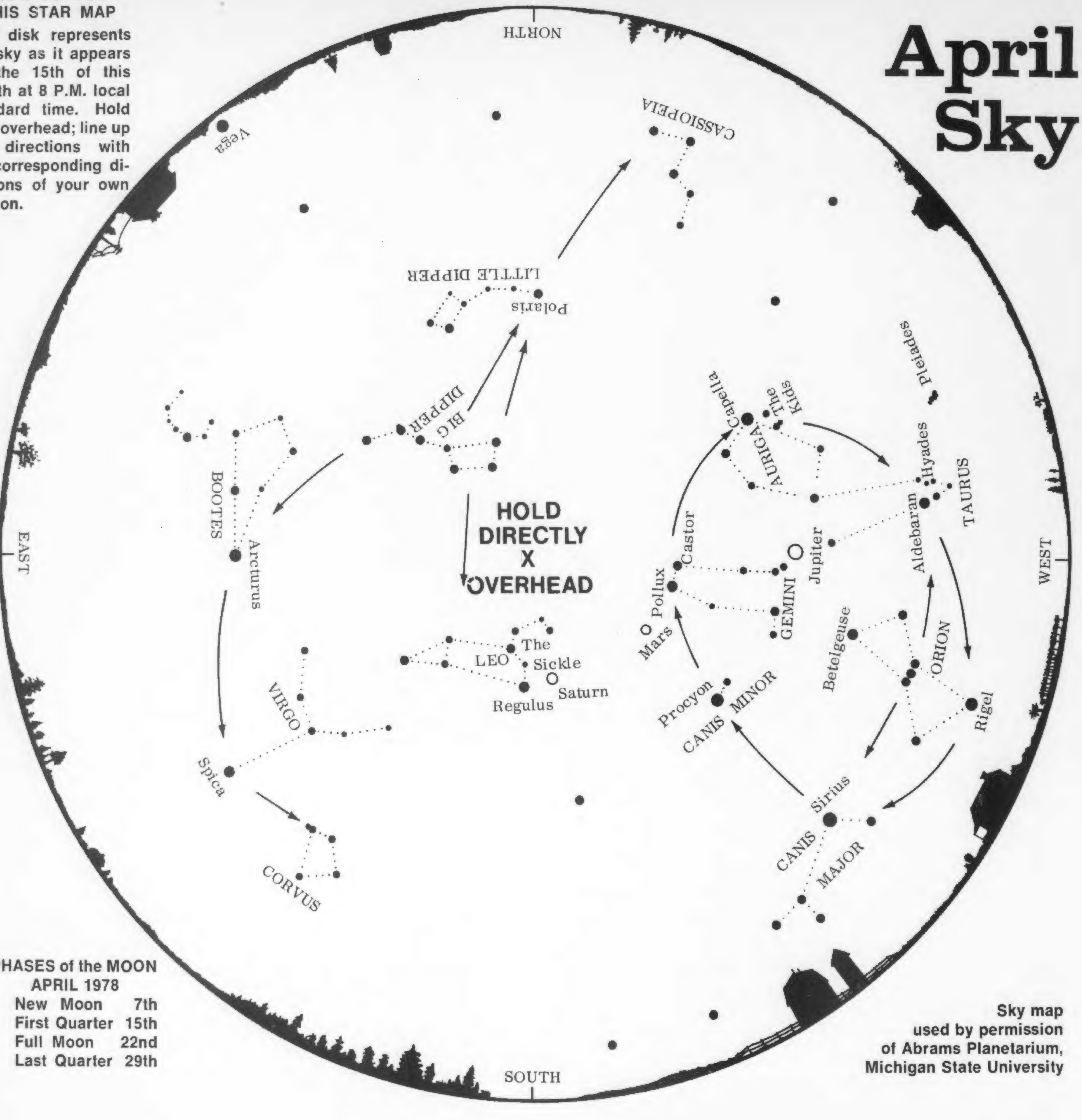
For free literature on the educational uses of OSCAR, write on school letterhead to Steve Place, ARRL, 22 Main St., Newington, Connecticut 06111.

Below, at ceremonies last summer, Comsat Laboratories donated the OSCAR radio terminal being demonstrated to the World Scout Organization headquarters in Geneva, Switzerland. L to R: Irving Feist, then World Scout chairman; Dr. Burton Edelson, director, Comsat Labs; Lucius D. Battle of Comsat; Joe Kasser of Comsat at the microphone talking to a California station via OSCAR 7; and (back to camera) Leonard Jarrett from Geneva. The station will work plugged into a 12-volt car battery. This portable unit is taken to Scout Jamborees; the next one is in Iran.

April Sky

HOW TO USE THIS STAR MAP

This disk represents the sky as it appears on the 15th of this month at 8 P.M. local standard time. Hold map overhead; line up the directions with the corresponding directions of your own horizon.


NORTH
CASSIOPEIA
Vega
LITTLE DIPPER
Polaris
BIG DIPPER
BOOTES
Arcturus
EAST
HOLD
DIRECTLY
X
OVERHEAD
The Sickle
LEO
Saturn
Regulus
VIRGO
Spica
CORVUS
Capella
The Kids
AURIGA
Pleiades
Hyades
TAURUS
Aldebaran
WEST
Jupiter
Castor
Pollux
GEMINI
Mars
Betelgeuse
ORION
Rigel
Procyon
CANIS MINOR
Sirius
CANIS MAJOR
SOUTH

PHASES of the MOON
APRIL 1978

New Moon	**7th**
First Quarter	**15th**
Full Moon	**22nd**
Last Quarter	**29th**

Sky map used by permission of Abrams Planetarium, Michigan State University

by Dennis Mammana
Planetarium Production Specialist
National Air and Space Museum

The April sky signals the approach of spring. Orion the Hunter, Taurus the Bull, and the other winter constellations are sinking low in the west. If you have a clear view of the southwestern horizon, watch the brilliant bluish-white star Sirius, the brightest star of the night, as it sets shortly after dark. When near the horizon, Sirius flickers and changes color rapidly like a Fourth of July sparkler.

Appearing high in the northeastern sky this month is the Big Dipper. The Dipper is very useful for finding other stars and constellations. Use the arrows on the star map to find Spica in Virgo, Arcturus in Bootes, and Polaris, the North Star.

Three planets are visible in the western sky shortly after sundown this month. Venus is the brilliant "star" low in the west, and Jupiter is the bright object high in the western sky. Watch from week to week as Jupiter drifts slowly eastward into the constellation Gemini. If you are lucky enough to have a clear view of the west you may spot Mercury very near the horizon shortly after sunset during the first few days of April.

Almost directly overhead is the red planet Mars. Also nearly overhead lies Saturn, located this month slightly northwest of Regulus, the brightest star in Leo, the Lion. Saturn's yellowish hue distinguishes it from Regulus, a white star. Although the planets Saturn and Mars are nearly the same brightness this month, Mars appears slightly more orange than Saturn.

Watch for the crescent Moon to pass near Venus on the 8th and near Jupiter on the 13th. Between these two dates Venus, the Moon, and Jupiter should make a very pretty sight at sunset. The Moon passes near Mars on the 16th and near Saturn on the 17th.

On the 11th, the Moon will appear very near the bright star Aldebaran in Taurus. In just a few hours you can watch the moon drift slowly eastward past Aldebaran as it moves in its orbit around the Earth.

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☐ Other (social, arts, business, etc.)

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☐ Elementary or middle school
☐ High school or prep
☐ Adult (teachers' college, aerospace workshops, counseling, etc.)
☐ Wide range (as in museums)

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☐ School, museum, planetarium
☐ Professional society, government, or non-profit organization
☐ Business

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National Air and Space Museum
Room 3569
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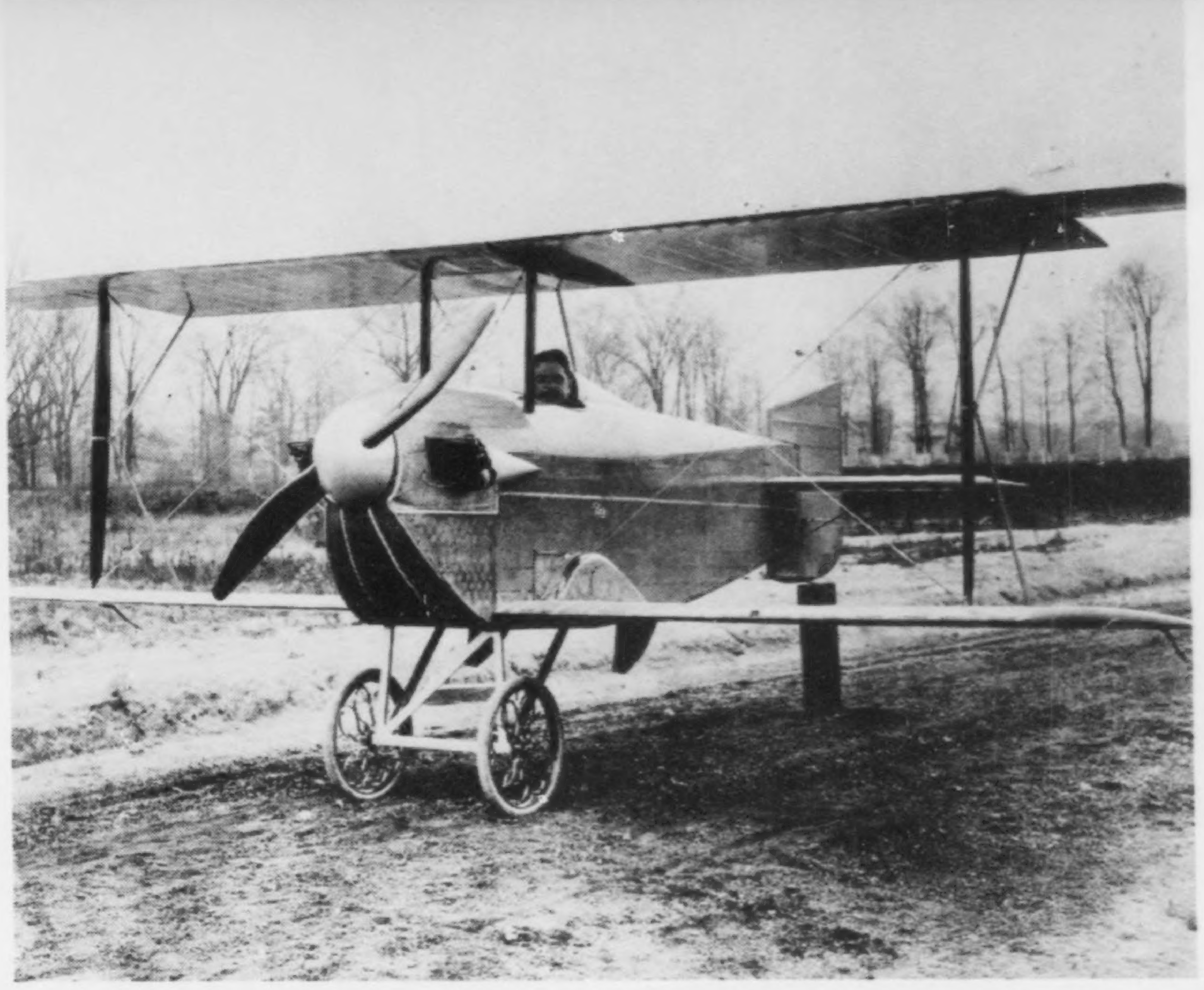

FAMOUS AND OBSCURE PLANES, NO. 2

By Walter J. Boyne
Curator of Aeronautics
National Air and Space Museum

HUGHES H-1

In 1935, Howard Hughes' record-breaking H-1 racer was perhaps the world's most sophisticated aircraft, and its advanced features, including flush riveting, butt-jointed skin, bell cowling and others, influenced aircraft designers all over the world.

Hughes personally tested the beautiful low wing monoplane, and on September 13, 1935, set a world land speed record of 352.322 mph. At this time the H-1 was fitted with a tiny 25-foot span wing. For his transcontinental record, set on January 19, 1937, Hughes modified the exquisitely crafted plane with a 31'9" span wing. He flew from Burbank to Newark Airport in just over 7 hours and 28 minutes, averaging 322 mph. Hughes intended to cap the H-1's achievements with double victories in the 1937 Bendix and Thompson Trophy races. A protest of "unfair competition" from other race pilots caused him to change his plan, and the H-1 was returned to a temperature and humidity-controlled hanger where it waited 39 years until it was suspended in the Flight Technology Gallery in the new National Air and Space Museum.

MARTIN KITTEN

Seven miles away, in the Museum's Silver Hill facility, there hangs an aircraft which could not present a greater contrast to the immaculate H-1. It is the tiny Martin Kitten, an ugly little biplane made in 1918 that set no records, excited little comment and inspired few designers. Yet the Kitten, for all its awkwardness, had almost as many startling technological innovations as the Hughes H-1.

The plane's designer, J. V. Martin, was proud of the Kitten and its unusual features, but unfortunately all but one of them came to an aerodynamic dead end. The one exception was notable, however, for the Kitten has the first practical example of the retractable landing gear.

Martin himself was a genuine pioneer, but he had an unfortunate penchant for bombast and litigation which hampered his career. He made valiant claims for the tiny 17'11¼" wingspan biplane (112 mph top speed, 20,000 ft ceiling, etc.) but in fact, the Kitten never flew in a controlled manner nor out of ground effect. It now hangs higher than it ever flew, an interesting example of some ideas whose time never came and one idea—the retractable landing gear—which became timeless.

The Gossamer Condor

Continued from Page 7

In turning 150° to 180°, Gossamer Condor does not bank (tilt) more than 3°.

The huge craft taxis on wheels from a toy engine. When the pilot begins pedaling, Gossamer Condor immediately responds and lifts off within 20 feet.

Bryan Allen, who piloted the victory flight, won bicycle races at his high school in Tulare, California, and taught himself hang-gliding. Age 24, weight 137 pounds, he found he could provide a 0.35 horsepower (hp) drive for 30 minutes, 0.45 hp for 7 minutes, and 1.2 hp in bursts. The prizewinning flight was his 223rd in the Condor. He covered the figure-8 course traveling 1.15 miles through the air with a total flight time of 7 minutes, 28.5 seconds.

Readings

Aeronautics and Astronautics, September, 1977, "At the Threshold of Man-Powered Flight," by John J. McMasters and George M. Palmer. This is a good overview with many references and sources which the serious researcher will find invaluable.

Aeronautics and Astronautics, October, 1977, "Beyond the Threshold of Man-Powered Flight." The same authors note that "The prize-winning Condor differs considerably from the original configuration described in our previous article." They detail the differences.

Air Progress, January 1978, "The Gossamer Condor," by Jack Lambie, who helped to build the craft and vividly describes people and events.

(Students can locate other articles by reference to the *Readers' Guide to Periodicals* in any library.)

ILLUSTRATION CREDITS

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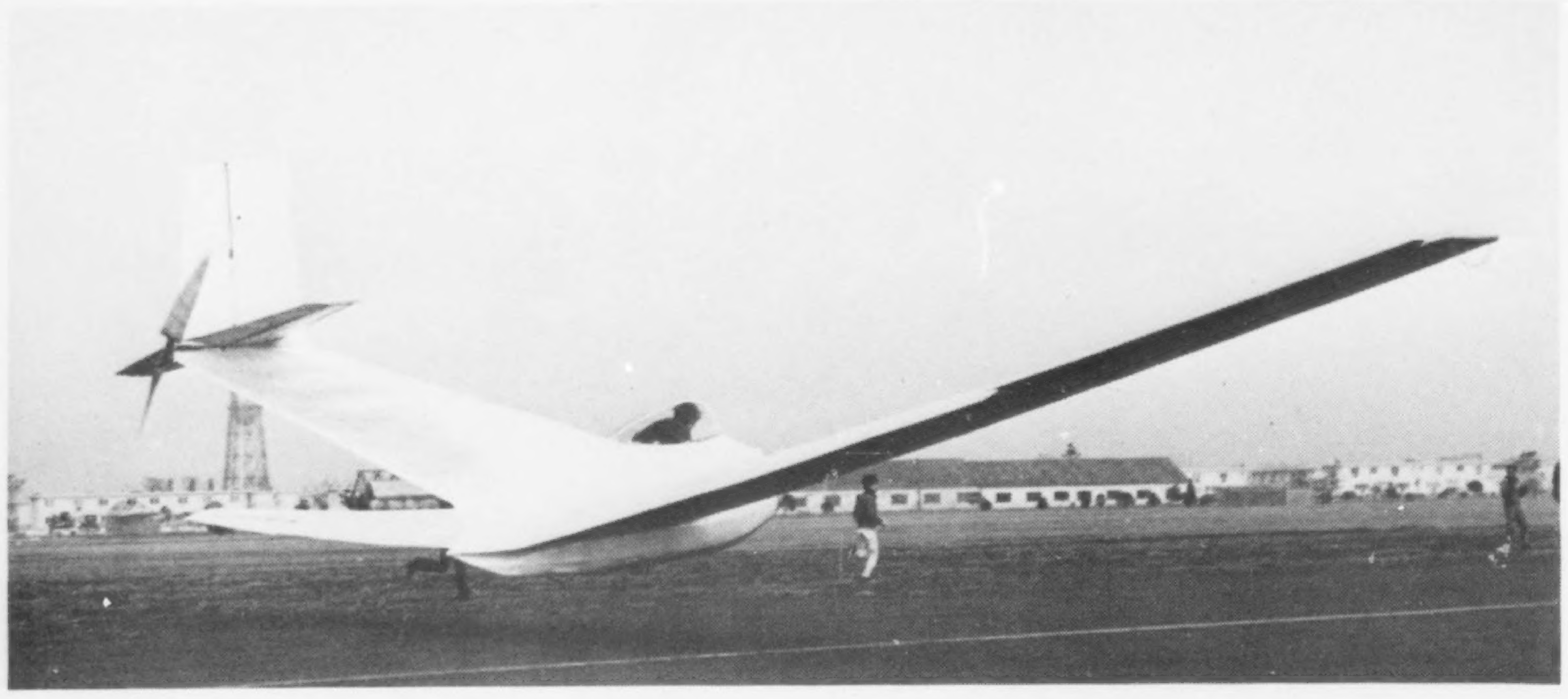
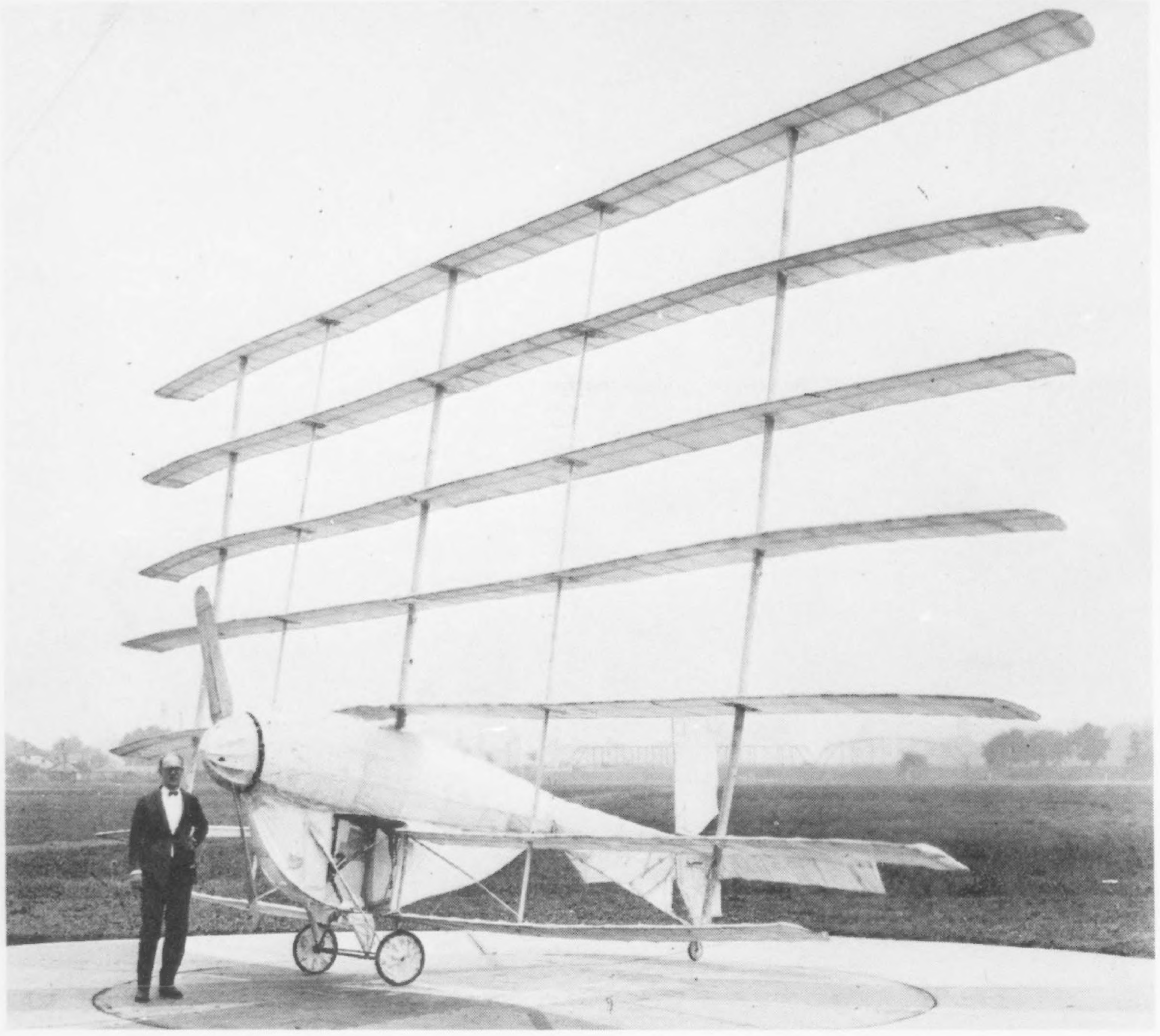
THINK ALONG WITH THE AEROSPACE ENGINEERS

on man-powered flight –





Two of many novel constructions tried over the years for man-powered flight are the Linnet II, top, and the Gerhardt Cycloplane, below. The latter was built at McCook Field, Dayton, Ohio, in 1923. Neither reached the goal of sustained flight.

by Tim Wooldridge
Aeronautics Dept., National Air and Space Museum

Linnet II (top left), the Gerhardt Cycloplane (lower left), Toucan, SUMPAC, Puffin and Olympian AB-1 have not exactly become household words, but to the man-powered flight (MPF) enthusiast, they all represent significant milestones along the road to sustained, maneuverable flight. Much of the mystery associated with MPF was solved on August 23, 1977, when the Gossamer Condor won the coveted Kremer prize of £50,000 (see Pages 6, 7).

Now, Henry Kremer offers £100,000 for a successful man-powered flight across the English Channel, a distance of 23 miles.

A new set of questions has now been posed for students to debate. Should the basic design of the Gossamer Condor be retained, or will the requirement for long-distance flight impose a new set of design criteria? How will the flight profile differ from that flown in the first Kremer course? Can one person supply the muscle-power necessary to propel the craft for a trip of over two hours? Or will it be necessary to have a copilot or two along? What weather conditions will be limiting factors? And how many days of the year can acceptable weather conditions be expected in the English Channel?

In summary, aircraft design, weather, human endurance, logistics, and financial considerations will all play significant roles. Perhaps a successful flight of this nature may eventually lead to a practical application of MPF technology. Follow-on Gossamer Condors may no longer be confined solely to the realm of sport aviation.

NATIONAL AIR AND SPACE MUSEUM
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